International Journal of Textile
and Fashion Technology (IJTFT)
ISSN(P): 2250-2378; ISSN(E): 2319-4510
Vol. 12, Issue 1, Jun 2022, 11–20

TRANS STELLAR
•Journal Publications •Research Consultancy

FABRIC TREATMENT WITH BIOSYNTHETIC SILVER NANO PARTICLES USING PLANT EXTRACT

SRINIVASULU K., HAYAVADANA J., ANUSHA A. & PRAGATHI P.

Department of Textile Technology, University College of Technology, Osmania University, Hyderabad, India.

ABSTRACT

Cotton fabric was treated with green synthesized Silver Nano Particles (AgNPs) using a mixture of Neem, Mango and Tulasi extract as a reducing agent in the batch method. Chemical reduction methods were followed for Nano particles formation by adding the extract to Silver nitrate solution in drops. The liquid was then applied to enzymatic pretreated fabric using padding mangle. Both liquid and fabrics samples are characterized using Particle Analyzer (DLS), Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and UV-Spectrophotometer. Average Particle size found 98nm and Zeta Potential was -45 to 55(mV). The purity and crystalline nature of AgNPs were confirmed based on the XRD assessment. In addition, specific functional groups, which led to silver nitrate reduction in AgNP formation, were examined using FTIR. Antibacterial activity assays with Gram Positive and Gram negative demonstrated that AgNPs reduced bacterial growth and produced well-defined inhibition zones.

Key words: Biosynthesis, Anti-Bacterial, Toxic, Biodegradable, Phytochemicals, Zone of Inhibition.

Received: Oct 20, 2021; **Accepted**: Nov 10, 2021; **Published**: Feb 24, 2022; **Paper Id**: IJTFTJUN20222

Original Article

1. INTRODUCTION

Textile finishing is the term used for a whole range of mechanical and chemical processes that are used on textiles after their manufacture to provide desired qualities. Finishes are classified into two types, namely aesthetic finishes and functional finishes on the basis of properties imparted on the textiles after treatment. One of the different types of functional finishes is the antimicrobial finish. This finish inhibits the growth of microbes on the textile surface with the help of antimicrobial agents. There are many organic, metallic and inorganic compounds which can impart antimicrobial properties, butare toxic and do not easily degrade in the environment. These facts lead to the development of antimicrobial agents that are non toxic, biodegradable from natural sources like plants, usually termed as bioactive agents. A Bioactive agent is well defined as a component with activity against microorganism's growth.

Nanotechnology plays a significant role in the textile process by improving textiles at the molecular level, and enhancing their durability and performance. Nanoparticles from Metallic compounds are impregnated onto the textile substrate without significantly affecting their morphology or comfort.[1]

Various techniques are available for the Synthesis of Nano particles but green synthesis is a versatile method where there is no harm to the environment and it is not cost effective.

Green synthesis has become an alternative to the conventional techniques for the synthesis of Nano particles and which are more compatible with textile substrate. Bio synthesis process is used not only in silver but most often in other metallic nano compounds. Moreover, plant based extract will have more impact on intercellular

textile fabrics.

2. MATERIALS AND METHODS

2.1. Materials

The materials are:

- Bleached cotton fabric is bought from Deewan textiles.
- Silver nitrate (AgNO3) is collected from CRE Lab of University college of technology (A) Osmania University,
- The leaves of Neem, Mango and Tulasi were collected from the botanical garden Osmania university.

Table 1 Geometrical Properties Of Cotton Fabric.

S.No	Particulars	Sample 1
1	Length(m)	2
2	Width(m)	1
3	GSM(gm/m2)	99.09
4	Ends/inch(n1)	104
5	Picks/inch (n2)	64
6	Warp count(N1)	32
7	Weft count (N2)	35
8	Warp crimp (C1)	6
9	Weft crimp (C2)	10
10	Thickness(cm)	0.19

3. METHODOLOGY

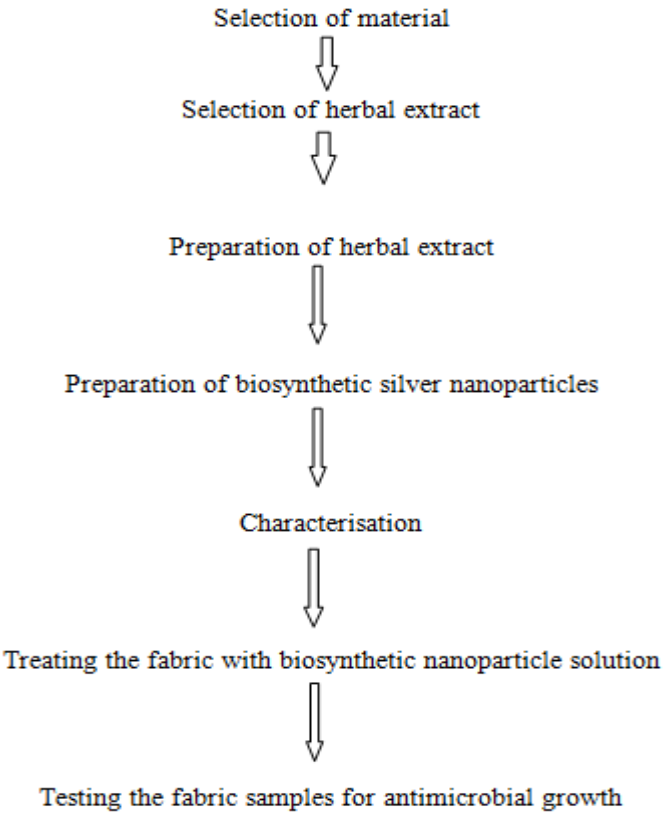

Figure 2: Flow Chart

3.1. Preparation of Herbal Extract:

The aqueous plant extract was prepared by collecting selected leaves of the plant from the university college of technology, Osmania university premises. The leaves of 25 grams were weighed and washed thoroughly with double distilled water to remove dust and natural oils. Then 100ml of double distilled water was added to cleaned leaves and boiled for 20min and then bring down the solution to room temperature. The above mixture is filtered using A1 grade filter paper of Molychem. The plant extract solution was preserved for the synthesis of nano particles.

Figure 3: Herbal Extract obtained from Combination of Three Leaves(Mango, Neem and Tulasi Leaves)

3.2. Preparation of Biosynthetic Nanoparticles

Herbal extract of 5mLwasthen added dropwise to 100 mL of 1 mM precursor($AgNO_3$) solution at 37ºC, then the solution was stirred well using a magnetic stirrer at speed of 200rpm for 30min. After 30 min the change in color was observed from pale yellowish to dark brown and which indicates the formation of nano particles.

Figure 4: Formation of Nano Particles

3.3. Characterization

The prepared silver nano particle solution was kept for 4 hrs observation in a dark room for development of nanoparticles then the solution is taken into 10ml voiles for characterization using Scanning electron microscopy, FTIR, X-Ray Diffractometer and Particle analyser. The nano particles range was found to be 86-105nm with 45-55(mV) zeta potential. FTIR spectrum shows absorption bands at 3500, 3200, 1750, and 475 cm^{-1} indicating the presence of capping agent with the nano- particles. The bands at 3500, 3200 cm^{-1} in the spectra correspond to O-H stretching vibration indicating the

presence of alcohol and phenol.

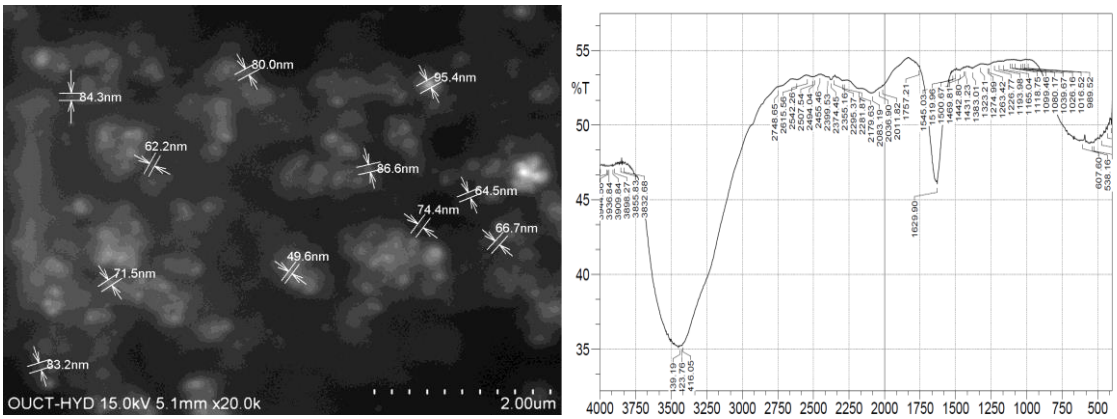

Figure 5: A) SEM Images of Silver Nanoparticles B) FTIR Spectra Nanoparticles

3.4. Fabric Treatment with Biosynthetic Nanoparticles

Bleached cotton fabric immersed in biosynthetic silver nanoparticle solution kept for 4hours and then taken out and dried in shade. The cotton-treated fabric became greyish brown.

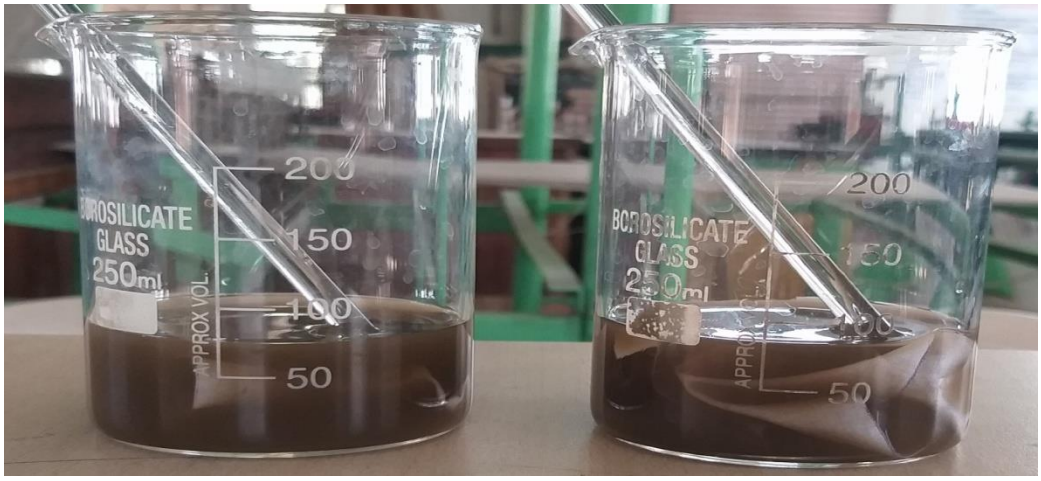

Figure 6: Treatment of Bleached Cotton Fabric with Silver Nanoparticle Solution

3.4.1. SEM Images of Fabric Treated with Agnps Solution

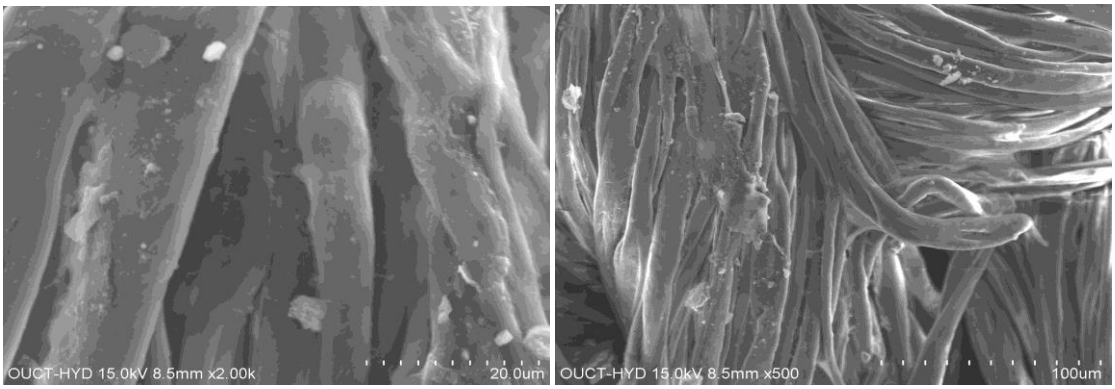

Figure 7: SEM Images of the Fabric Treated with Silver Nano Particle Solution

4. TESTING ANTIBACTERIAL ACTIVITY

4.1. Requirements

- Active cultures of Gram positive and Gram-negative bacteria.(Gram positive bacteria - *Staphylococcus* and Gram-negative bacteria - *Klebsiella* were selected)
- Nutrient agar media
- Routine lab equipment

4.2. Preparations of Active Cultures

- The bacterial cultures were activated by transferring a pure bacterial colony into 50ml nutrient broth media taken in a 150ml conical flask and incubation for 8-12hrs.

4.3. Antibacterial assay

- The bacterial test was conducted by performing pour plate method in which 1ml bacterial active cultures per plate were mixed into agar media before solidifying temperature and poured into plates. Here *Bacillus* and *Escherichia coli* were selected as Gram positive and Gram-negative bacteria respectively. Wells were made using sterile well borer and samples were loaded 100µl each respectively in Gram positive and Gram negative plates. Plates were incubated at 37 degrees for 48 hours. The cloth samples were cut into round 2cm pieces and placed in the middle of the bacterial plates.

Table 4.2: Zone Of Inhibition (In Cms) of Treated Samples When Bacillus and Escherichia Coli were Selected as Gram Positive and Gram-Negative Bacteria

Sample	Bacillus G +ve(zone of inhibition cms)	E.ColiG - ve(zone of inhibition cms)
Cloth 1 [4H]	**1.5**	**0.3**
Cloth2 [2H]	**1.3**	**0.2**
Cloth 3 [1H]	**1.1**	**0.2**
Liquid1	**1.7**	**0.4**
Standard	**2.0**	**0.5**

4.4. Images of Antibacterial Activity on our Samples

4.4.1. Liquid Sample

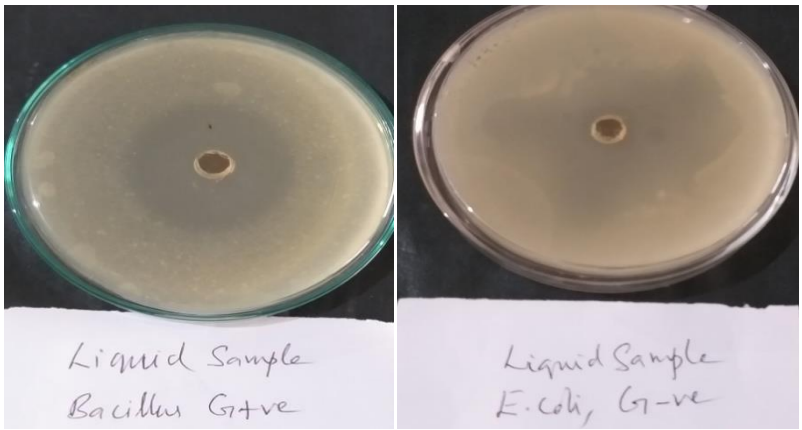

Figure 8:Image Showing Antibacterial Activity of the Silver Nanoparticle Solution

Biosynthetic silver nanoparticle solution has shown a significant antibacterial activity against Gram negative bacteria (E.Coli) and Gram positive bacteria (Bacillus)

4.4.2. Fabric Sample 1

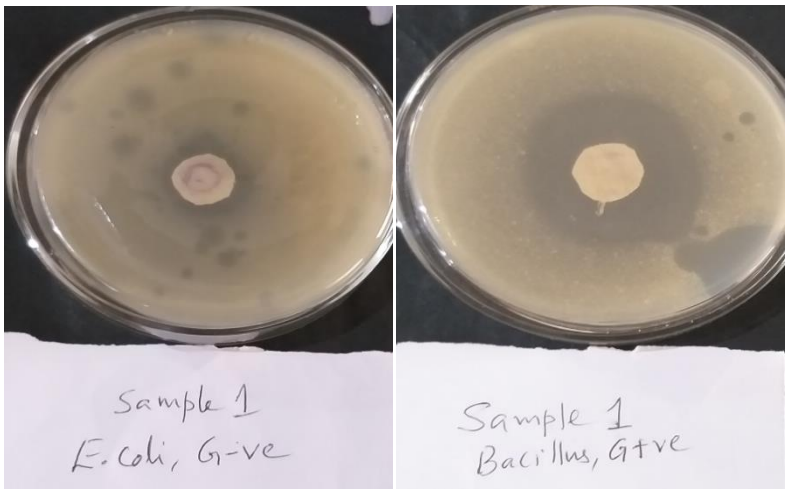

Figure 9: Image Showing Antibacterial Activity of the Fabric Treated with Silver Nano Particle Solution for 4 Hrs.

4.4.3. Fabric Sample 2

Figure 10: Image Showing Antibacterial Activity of the Fabric Treated with Silver Nano Particle Solution for 2hrs.

4.4.4. Fabric sample 3

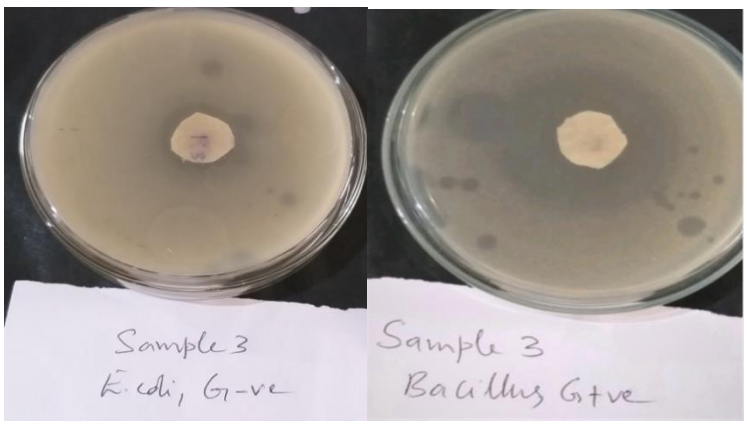

Figure 11: Image Showing Antibacterial Activity of the Fabric Treated with Silver Nano Particle Solution for 1 Hr.

After studying the results obtained., it can be interpreted from the tested samples that antimicrobial activity shown by the fabric sample treated for 4 hours is higher than that of the sample treated for 2 hours followed by the least activity shown by the sample treated for 1 hour.

5. CONCLUSIONS

Antimicrobial finishing of Textile fabrics become essential in vogue as fabrics are exposed to different environmental conditions. Treating fabrics with silver nano particles show better antimicrobial activity, durability more compatible with cotton fabric. The major classes of antimicrobial agents for textile finishing applications are plant based natural products, and photoactive antimicrobial agents. Bio synthetic nano finishes show excellent protection against moths, microbes etc. Nano particles size was found to be 85-105nm shows the potentiality of phytochemicals of plant leaves. Fabric with Synthesized silver nano particles revealed excellent inhibition for 4 hrs duration than 1 hr against selected bacteria. Cotton fabric exhibits excellent protection against gram positive bacteria than gram negative. Thus cotton fabric treated with bio synthetic silver nano particles can be applicable in various fields like medical, healthcare etc.

REFERENCES

1. *Bhati-Kushwaha, H., & Malik, C. P. (2014). Biosynthesis of silver nanoparticles using fresh extracts of Tridax procumbens Linn. Indian Journal of Experimental Biology, 52(4), 359–368.*
2. *Kaur, A., Saraf, A., & Kumar, K. (2017). Green Synthesis of Silver Nanoparticles (Ag-NPs) Using Plant Extract For Antimicrobial and Antioxidant Applications : A Review. International Journal of Adavance Research in Science and Engineering, 6(10).researchgate.net/publication/333448187_Green_Synthesis_of_Silver_Nanoparticles_AgNPs_Using_Plant_Extract_For_Antimicrobial_and_Antioxidant_Applications_A_Review*
3. *Anwar, S., A. Almatroodi, S., Almatroudi, A., Allemailem, K. S., Joseph, R. J., Khan, A. A., Alrumaihi, F., Alsahli, M. A., & Husain Rahmani, A. (2021). Biosynthesis of silver nanoparticles using Tamarix articulata leaf extract: an effective approach for attenuation of oxidative stress mediated diseases. International Journal of Food Properties, 24(1), 677–701. https://doi.org/10.1080/10942912.2021.1914083*
4. *Jyoti, K., Baunthiyal, M., & Singh, A. (2016). Characterization of silver nanoparticles synthesized using Urtica dioica Linn. leaves and their synergistic effects with antibiotics. Journal of Radiation Research and Applied Sciences, 9(3), 217–227. https://doi.org/10.1016/j.jrras.2015.10.002*
5. *Balashanmugam, P., & Kalaichelvan, P. T. (2015). Biosynthesis characterization of silver nanoparticles using Cassia roxburghii DC. aqueous extract, and coated on cotton cloth for effective antibacterial activity. International Journal of Nanomedicine, 10, 87–97. https://doi.org/10.2147/IJN.S79984*
6. *Omidi, S., Sedaghat, S., Tahvildari, K., Derakhshi, P., & Motiee, F. (2018). Biosynthesis of silver nanoparticles with adiantum capillus-veneris l leaf extract in the batch process and assessment of antibacterial activity. Green Chemistry Letters and Reviews, 11(4), 544–551. https://doi.org/10.1080/17518253.2018.1546410*
7. *Vankar, P. S., & Shukla, D. (2012). Biosynthesis of silver nanoparticles using lemon leaves extract and its application for antimicrobial finish on fabric. Applied Nanoscience (Switzerland), 2(2), 163–168. https://doi.org/10.1007/s13204-011-0051-y*
8. *Saha, A., Giri, N. K., & Agarwal, S. P. (2017). Silver Nanoparticle Based Hydrogels of Tulsi Extracts for Topical Drug Delivery. 5(1).*
9. *Keat, C. L., Aziz, A., Eid, A. M., & Elmarzugi, N. A. (2015). Biosynthesis of nanoparticles and silver nanoparticles.*

Bioresources and Bioprocessing, 2(1). https://doi.org/10.1186/s40643-015-0076-2

10. *Bonde, S. R., Rathod, D. P., Ingle, A. P., Ade, R. B., Gade, A. K., & Rai, M. K. (2012). Murrayakoenigii -mediated synthesis of silver nanoparticles and its activity against three human pathogenic bacteria. Nanoscience Methods, 1(1), 25–36. https://doi.org/10.1080/17458080.2010.529172*
11. *Prasad, R. (2014). Synthesis of Silver Nanoparticles in Photosynthetic Plants. Journal of Nanoparticles, 2014, 1–8. https://doi.org/10.1155/2014/963961*
12. *Saravanan, P., et al. "A study on extraction and application of eco-friendly natural dye extracted from leaves of Acalypha indica Linn on silk fabric." International Journal of Textile and Fashion Technology 3.5 (2013): 1-8.*
13. *Awate, Pankaj P., and Shivprakash B. Barve. "Formation and characterization of aluminium metal matrix nanocomposites." Technology 64.557 (2015).*
14. *Hasan, MD Mahamudul, Sutapa Chowdhury, and Kawserparveen Chowdhury. "Impact Of Neem In Case Of Antimicrobial Activity On Single Jersey Cotton Fabric." International Journal of Textile and Fashion Technology (IJTFT) Vol. 8.4, Aug 2018, 1-6 © TJPRC Pvt. Ltd.*
15. *GK, Njoroge, et al. "In Vivo Antidiabetic Potential And Safety Of Aqueous Extract Of Triticum Aestivum (Wheatgrass)." International Journal of Medicine and Pharmaceutical Science (IJMPS) Vol. 7. 1, Feb 2017, 77-84 © TJPRC Pvt. Ltd.*